Ubiquitous Network Technologies and Business Process Reengineering

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1. Introduction

The word ubiquitous signifying 'any time, anywhere' or 'state of being everywhere at the same time' has rapidly begun to gain currency. Though the mass media are using this term in various contexts, 'ubiquitous network technologies' discussed in this paper mean technologies for realization of a computer network that is available at any time and from anywhere.

Many researchers assert that a company must revolutionize its operations process and business model in order to respond to the change in its circumstances. Though the thought is consistent with reality, this matter has to be looked into further, because the company can adapt itself to the change in its surroundings easily if it is gentle and slow.

But the company's environment sometimes undergoes a sudden and discontinuous change. In such a case the company is forced to reconstruct its operations process and business model. Such a drastic change includes a local one like the competitor's entry into its domain, while there is also a structural one which has a great influence on all subjects in the economy, including the company.

Appearance of a ubiquitous network society is a typical example of the latter, and it is affecting the company greatly. There are a lot of researches on the convenience of our daily life promoted by it, but there are few treatises that investigate its influence on the business process of the company comprehensively.

This paper focuses on this topic intensively, and deals with importance of reengineering the operations process of the business.

2. New Stage of Information Technology Innovation

According to Weiser (1991), a ubiquitous network or ubiquitous computing does not mean just computers that can be carried to the beach, jungle or airport, but means specialized elements of hardware and software that can be connected to a worldwide information network by wires, radio waves and infrared rays.

In the ubiquitous network society the computing environment knows the goods, to give an example, the suit, you looked at for a long time last week because it tracks and grasps your locations, and it can retroactively find the designer's name even though that information did not interest you at the time. Plainly speaking, when almost every object either contains a computer or has a tag attached to it, obtaining information will be trivial. Weiser says, "There is more information available at our fingertips during a walk in the woods than in any computer system, yet people find a walk among trees relaxing and computers frustrating. Machines that fit the human environment instead of forcing humans to enter theirs will make using a computer as refreshing as taking a walk in the woods" (p. 75).

We will use many information appliances equipped with ubiquitous, invisible computers in the near future as Weiser says, and it is now coming true. The typical infrastructure and device that will support the ubiquitous network society are IPv6 and RFID (Radio Frequency Identification) tags. Various things used in everyday life such as a kitchen counter, furniture, a refrigerator and other electric articles can be connected to the Internet by utilizing the two.[*1]

In other words, the ubiquitous network allows all users to access and exchange information and data of any kind freely at any time, from anywhere, and from any appliance through the use of broadband and mobile access as well as intelligent home appliances and RFID tags that can access networks

(Ministry of Public Management, Home Affairs, Posts and Telecommunications, 2004). The information society has now, so to speak, entered a new phase. It is not too much to say that the information technology innovation whose essence is development and diffusion of ubiquitous network technologies is bringing about a major historical transformation of society that is comparable to the Industrial Revolution of the 18th century (Murakami, 2001).

3. Revolution of Business Process

Almost all of the executives and managers tend to be tied to their existing system and operations process. They are apt to think deductively. That is, they are good at defining a problem, then seeking and evaluating different solutions to it, and they perform such tasks thinking of the present technology and business process (Hammer & Champy, 1993). But to recognize the power inherent in ubiquitous network technologies and to visualize their application demands a progressive idea and changing their way of thinking.

The fundamental error that most companies commit when they look at technology such as IT is to view it through the lens of their existing processes (Hammer & Champy, *op. cit.*). They ask, for instance, "How can we use this technology in order to enhance or improve what we are doing?" Instead, they should ask, "Technology has made remarkable progress. How can we use its capabilities and functions in order to do things which we are not doing?". In short, it is important to exploit the latest advantages of information technology to achieve entirely new goals, that is to say, reengineer the business process.

Business process reengineering should begin with no assumptions and no givens. It must be radical redesign (Hammer & Champy, *op. cit.*).

Radical redesign means getting to the root or base of things : not making superficial changes or fiddling with what is already in place, but breaking with tradition and throwing away the old. The reengineering means disregarding all existing structures and procedures, and it aims at inventing completely new ways of performing work. In this sense the reengineering is about business

reinvention, not business improvement, business enhancement, or business modification.

4. Business Process Reengineering with Ubiquitous Network Technologies

It is widely said that in a ubiquitous network society information technology will be used in the following ways, and some of them are coming true:

- Capture detailed information about customer behavior in a shopping mall
- Record information about items customers selected or purchased
- Detect medicines and prevent errors concerning dosages and combinations
- Provide information about barrier-free facilities based on the impaired person's position
- Monitor the house or office while out
- Operate home appliances such as confirming contents of a refrigerator
- Give some accurate information on the production history of food
- Delivery information related to the exhibits at museums and various product shows
- Receive and enjoy movies and music at any time and anyplace

etc.

In the ubiquitous network society various customer services will be possible as stated above. In a word, in line with advances in ubiquitous network technologies that can recognize users' locations and understand their characteristics, a variety of user-centric services are becoming more widespread than the traditional company-oriented IT services (Yamazawa & Ozaki, 2004 ; Yamada, Saruwatari & Ozaki, 2004).

But such services seldom become the basis of business process reengineering or the seeds of new business. As Takahashi (2005) says, though such services as above will improve customers' satisfaction, it will be very difficult for the providers of them to add the costs to implement them to the prices. When many competitors allow consumers to get ubiquitous network based information without spending much money, the company cannot help doing so. Giving a

brief account of it, they are the factors of expense rather than the sources of profit.

The real power of new technology whose typical examples are IPv6 and RFID tags is not that it can make the present processes work better, but that it enables organizations to break them and create new ways of working, that is to say, to reengineer. It is this disruptive power of new technology, its capability to destroy the process which limits how managers and employees conduct their work and lays them under restraint, that makes it critical to companies trying to build competitive advantage, strictly speaking, to realize lower cost or larger revenue than their competitors.

Moreover, the reengineering often builds a new business model in consequence (Figure 1). Performing the operations process in the way which is entirely different from the past frequently creates the outputs that can be sold and become new sources of revenue. To be concrete, in major industrial sectors such as manufacturing, distribution and finance, the spread of sensing will trigger innovation not only in the operations process but also in the business model (Nagumo, Nakajima & Okano, 2001).

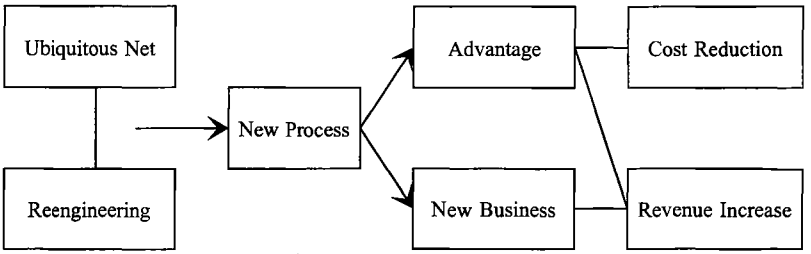

Figure 1 Effects of Business Process Reengineering with Ubiquitous Network Technologies

How do businesspersons think about the merits of ubiquitous network technologies in case that they utilize the technologies in their business? Do they

notice their large potentiality as the basis of business process reengineering?

According to the Ministry of Public Management, Home Affairs, Posts and Telecommunications (2004), there is a difference in thoughts about the merits of a ubiquitous network that will have an impact on business between Japanese companies and American ones (Table 1). Compared to in the United States, in Japan there is a stronger awareness of the 'ability to use networks regardless of location' and 'ability to trace and manage historical data using RFID tags'. This view of a ubiquitous network can develop into utilizing it as the basis of business process reengineering.

To tell the truth, Hammer & Champy (1993) give the case of changing the state being 'You have to find out where things are' into the state being 'Things tell you where they are' with automatic identification and tracking technology as one of typical patterns of the reengineering.[*2]

As for the American companies, there is a higher awareness of 'improved network stability.' It is not the conception of the reengineering, because the improved network stability can make the business process more efficient but will not revolutionize the process.[*3]

So far as the RFID tag is concerned, it is expected as a new tool for SCM (Supply Chain Management), CRM (Customer Relationship Management), Inventory Management, customization of products, and as a new platform of collaboration across companies and across boundaries within the internal organization (Takahashi, *op. cit.*). In the SCM and the Inventory Management of them, it can bring forth the reengineering as its functions of identification and tracking work very effectively there.

5. Some Companies' Experiments

As stated in the former chapter, a ubiquitous network can become not only the tool for improving customers' satisfaction but the basis of business process reengineering. Many managers regard it only as the former, but it is usage as

Japan

1. Ability to use networks regardless of location (61.2)
2. Ability to exchange large volumes of data at low cost (58.5)
3. Historical tracing and management using RFID tags (55.0)
   Ability to use information and communications devices with simple operation (55.0)
5. Ability to use information and communications terminals for a variety of applications (53.0)
6. Provision of services and management tailored to each individuals and items (45.9)
7. Intelligent home appliances that have communications functions (42.2)
8. Communications with high security levels (40.6)
9. Promotion of the use of monitoring and sensing (39.9)
10. Effective use of GPS and other position information (31.4)
11. Provision of services from all terminals and networks (31.3)
12. **Improved network stability** (24.6)

United States

1. Ability to exchange large volumes of data at low cost (56.6)
2. Ability to use information and communications devices with simple operation (51.8)
3. Communications with high security levels (49.8)
4. **Improved network stability** (46.1)
5. Ability to use information and communications terminals for a variety of applications (45.5)
   Promotion of the use of monitoring and sensing (45.5)
7. Provision of services from all terminals and networks (38.6)
8. Ability to use networks regardless of location (35.9)
9. Historical tracing and management using RFID tags (35.3)
10. Effective use of GPS and other position information (35.0)
11. Provision of services and management tailored to each individuals and items (29.5)
12. Intelligent home appliances that have communications functions (26.0)

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications (2004) 'Survey of Ubiquitous Network Usage Trend by Businesses'

Note: Comparison of percentages in companies engaged in business-to-business commerce
Multiple responses possible

Table 1 Merits of a Ubiquitous Network That Will Have an Impact on Business and Comparison of Awareness in Japan and the U.S.

the latter that brings a company great advantage and much profit. Some companies became aware of it and have already begun to use ubiquitous network technologies experimentally as the foundation of the reengineering. Good examples of such an attempt are as follows.

Mitsukoshi Department Store, assisted by NTT Comware, has been testing item-level RFID in the sales floor of shoes, Jeans, and so on. Formerly a shop clerk was compelled to go back and forth between a sales floor and a stock room in order to check availability of the goods which a customer took to with different sizes or colors, because the clerk didn't have inventory record which was kept up-to-date, or the customer did not believe that paper-based inventory record was accurate. Such a trip to the stock room required substantial time and resulted in lost sales opportunities, for the clerk's response to other customers were delayed.

In the Mitsukoshi's experiment, the clerk can use a scanner device to examine whether the goods requested by the customer is available in the right color and size, or the customer can do so for him/herself. Explaining it more concretely, the clerk has only to put the goods to which RFID tags are attached on the electric device which is the size of a palm, and he/she needs not to go to the stock room.

According to Mitsukoshi's press release, average time spent for serving each customer was reduced 50% from 12 minutes to 6 minutes, and the sales increased by 10% on account of this process reengineering (Nikkei Realtime Retail, 2005).

SECOM is running a new business that enables parents to monitor their children by means of its GPS tracking devices attached to their school bags, which send real-time information to SECOM's host computer. The name of this business is Coco-SECOM. SECOM introduced elementary school uniforms equipped with Coco-SECOM transmitter devices, too. This system using GPS and the tracking devices can pinpoint locations with outstanding precision, boasting accuracy of within five meters, and its technology is one of the best of its type

currently on the market.

Parents can check their children's location by accessing a special website for this service using a personal computer. At present, Coco-SECOM subscribers request searches via the website approximately 40,000 times a day (SECOM, 2005a).

A rise in abductions targeting children traveling between home and school has prompted concern over the increasing dangers facing children. The company announces that semiannual turnover of this business amounts to 13 billion yen (about 110 million US$) and its sales are on the increase (SECOM, 2005b).

Zojirushi launched a new business to respond to the needs in the aged society, which is called Mimamori (Monitor) Hot Line. It enables a customer worrying about his/her old parent's safety to monitor the person from a great distance. Zojirushi is carrying on this business by offering an air pot that sends information such as 'switch on' 'pour hot water' 'switch off' to Zojirushi's server computer every time some button on the upper part of the pot is pressed. Those who want to inquire after their old parent's health can obtain the record of sent information via the Internet supported by IPv6. The business like the Mimamori Hot Line of Zojirushi, which enhances the safety of seniors living alone, appears to be promising in the aged society.

FamilyMart convenience store tested the system 'EXPRESS POS' which utilized the RFID tags to realize a speedy checkout process for about one month between January 30, 2006 and February 24, 2006. It is what is called RFID-based automatic checkout system. FamilyMart (2005) said the main purpose of this experimental trial was to reduce the checkout process, and the trial could evaluate not only convenience for customers but also efficiency of shop operations. The Ministry of Economy, Trade and Industry, Itochu and Toshiba Tec cooperated with the company in the test.

In this trial, the RFID tags were attached to about 500 types of items (approximately 80,000 goods) including Onigiri (rice balls), boxed lunches, sweet buns, and beverages. The newly developed POS machine read multiple tags at

once, that is, identified all purchased items at the same time. Customers could also use electronic money, SUICA payment card (Super Urban Intelligent Card) at the checkout. The company reported the checkout processing became twice as fast as the conventional way (Nikkei Ryutsu Shimbun, 2006).*4

Obayashi which is one of the major companies in the construction business is developing a system for diagnosing sewer pipes using the RFID tags. The tags embedded inside the pipes send various data about their condition to the Obayashi's maintenance department. The staffs of the department can maintain records about each pipe and check problems with its condition, their connections, and so on by monitoring the data. Formerly they had to go around and check them on the spot. It took a full day to check the pipes of a building, but it will take only a few hours to do it with this system.

6. Issues that Need to be Resolved

The spread of ubiquitous network technologies such as RFID and IPv6 is bringing a company both opportunities and risks. In order that the company may use them as the reliable basis of business process reengineering, relevant technological infrastructures need to be studied.

In a ubiquitous network society, small-sized chips are incorporated into every physical object in the living space to attempt an automatic identification of information in the real world. There is little doubt that it will encourage wider applications in tracking and monitoring. The company can track positions of customers and things, and can also monitor their condition, while it entails some possibility that automatically identified personal information can be leaked out and be misused.*5

To solve the problem stated above, technologies that can protect security and privacy in the ubiquitous network society must be developed. Though other troubles may also occur there, the company had better place the greatest priority on issues concerning protection of personal information if it hopes to keep its customers' confidence in it.

7. Conclusion

As has been discussed, in the ubiquitous network society everything in our living space can be RFID-tagged, and everyone can freely obtain information at any time and anyplace through the Internet supported by IPv6 there. It is easy for a company to capture human behavior patterns there, so many information services based on the user's situation have been tried indeed. The company can provide various highly smart services that are tailored to suit the place, time, and occasion there.

But such services does not always bring the company an increase in profit, because it cannot put up the prices of the goods or charge its customers an additional fee. In order to make a large profit on using ubiquitous network technologies, it has to reengineer business process. Some companies have been trying it (Table 2), and all of them are making good use of the technologies' expanded tracking and sensing capabilities.

	Objective Process	Before Reengineering	After Reengineering
Mitsukoshi	Check inventory	Go to/from a stock room	Put goods on a device
SECOM	Detect a person's location	Go around	Auto-receive information
Zojirushi	Check a person's safety	Call him/her up	Auto-receive information
FamilyMart	Sum prices	Read each bar code	Read all data at once
Obayashi	Maintain equipment	Go around	Auto-receive information

Table 2 Examples of Business Process Reengineering Using Ubiquitous Network Technologies

Thinking about the technologies from a different point of view, they are raising the problem of how to prevent leak of private information. The spread of the technologies involves great risk that automatically identified personal information can be leaked out. Providing a solution to this problem is thought to be

important to give Japanese companies stronger international competitive advantage.

Notes

*1 Toyota Motor built an intelligent house of the near future whose name is BABI on an experimental basis in Nagakute, Aichi Prefecture. It has various kinds of furniture and electric articles by which users can access the Internet.

*2 There is a good possibility that introducing the automatic identification and tracking technology into the business process may bring about the reengineering. According to Hammer & Champy (1993), combined with wireless data communication, automatic identification technology lets things-trucks, for instance-tell us constantly where they are. We do not have to look for them, and when we want them to go someplace else, they get the word instantaneously. No more waiting for drivers to hit the next truck stop so they can telephone the dispatcher. A company that knows in real time where its trucks are, or rail cars or service technicians for that matter, does not need as many of them. It does not require as much redundancy in personnel, equipment, and materials to cover the delays inherent in locating and rerouting things and people in transit.

*3 In both Japan and the U. S. many companies believe one of impacts of a ubiquitous network on business will be the 'ability to exchange large volume of data at low cost'.

*4 It is said that ultimately we will able to go away from a store without meeting a cashier because the system will read data about the goods bought at the store and charge our credit card at its gate.

*5 According to the Ubiquitous ID Center (2004), incorporating tags such as RFIDs into everything is bringing about the following problems from a privacy point of view. First of all, RFID-stored information can be read by wrong people. Secondly, communications to realize various services can be tapped and private information can be leaked.

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